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NASA TECH BRIEF

This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the NASA space program.

New Cobalt Alloys Have High-Temperature Strength and Long Life in Vacuum Environments

The problem: Development of a cobalt-refractory-metal alloy which could withstand temperatures of up to 2,000° F in a high-vacuum environment.

The solution: The cobalt-refractory-metal class of alloys was selected for study because prior research promised the development of specific compositions of alloy that would combine the required characteristics of good workability (specifically, sheet formability) with high-temperature strength and low material loss in vacuum. The fact that cobalt has the highest Curie temperature of all metals was also of major significance in considering a cobalt-base alloy for the desired application (in turboelectric space-power systems).

Several specific binary and ternary cobalt-refractory-metal alloys were developed. The best combination of characteristics was found in the binary alloy Co-25W-1Ti-0.4C and in the ternary alloy Co-25W-1-Ti-1Zr-0.4C. At 1,800°F, the stress required to rupture as-cast specimens of the two alloys in 1,000 hours exceeded 10,000 psi, a characteristic which compares favorably with that of the strongest commercially available cobalt-base alloys. The new alloys, however, have a much lower evaporation-loss rate in vacuum than the commercial alloys. The new alloys also have high strength and good workability when annealed; they can, for example, be rolled to 0.050-inch sheet, while commercially available alloys of equal strength are generally in the form of castings. In the rolled condition, a room-temperature ultimate strength of 209,800 psi and a 25% elongation were obtained with the binary alloy.

Notes:

1. Because of their high-temperature strength and low volatility, these alloys offer advantageous industrial usage as components or structures in vacuum heat-treatment furnaces.
2. With protective coatings, the usefulness of the new alloys may be even more extended in an air environment.
3. The alloys can be cast without the close control of vacuum required for commercial cobalt alloys.
4. Among the properties of the alloys in this series that still need investigation are corrosion resistance to liquid metals, weldability, and possible embrittlement upon long-time use.
5. These alloys and their development, are described more fully in "A New Series of Cobalt-Refractory-Metal Alloys for Advanced Space Power Systems", by John C. Freche, R. L. Ashbrook, and S. J. Klima, Lewis Research Center, *Cobalt* (a quarterly publication on cobalt), No. 20, September 1963.

Patent status: NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA Headquarters, Washington, D.C. 20546.

Source: Lewis Research Center
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